

SUSTAINABILITY AND INNOVATION: A BIBLIOMETRIC STUDY ABOUT THE INTERNATIONAL PUBLICATIONS

SUSTENTABILIDADE E INOVAÇÃO: UMA PESQUISA BIBLIOMÉTRICA ACERCA DAS PUBLICAÇÕES INTERNACIONAIS

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ABSTRACT

This bibliometric study conducts an inventory on publications about the topic *sustainability and innovation* between 2002 and 2012. The data collection occurred in ISI Web of Science. The results showed, beyond the total papers (publications), 6 indexes on the topic and factors related to the *citation report*, such as the impact factor (h-b index and m index) of the publications. The results show a progressive increase in the number of publications every year, reaching its height in 2011. The English language is predominant. The USA is the country where the largest number of studies is from. Besides, from h-b index and m index is observed that the study of thematic title may be considered "hot-topic", in other words, important in the international scenario in the period from 2002 to 2012.

Keywords: Innovation; Sustainability; Sustainability and Innovation; Bibliometric.

RESUMO

Este estudo realiza um levantamento bibliométrico sobre as publicações acerca da temática *sustentabilidade e inovação* entre 2002 e 2012. A coleta de dados ocorreu na base *ISI Web of Science*. Nos resultados foram identificados, além do total de artigos (publicações), 6 índices sobre o tema e fatores relacionados ao *citation report*, tais como o fator de impacto (*índice h-b e m*) das publicações. Os resultados apresentam um progressivo aumento do número de publicações ano a ano, tendo seu ápice no ano de 2011. O idioma inglês é predominante, sendo os Estados Unidos o país de origem da maior quantidade de estudos. Ademais, a partir dos *índices h-b e m*, observa-se que o estudo da temática em epígrafe pode ser considerado "hot-topic", ou seja, de relevante representatividade no cenário internacional no período 2002 – 2012.

Palavras-chave: Inovação; Sustentabilidade; Sustentabilidade e Inovação; Bibliométrico.

1 INTRODUCTION

Nowadays, it is possible notice the emergency about social concerns and the policies for the environment and sustainability. In some way, it presents a fundamental influence on the innovation's rate and direction (ANDRADE, 2004). This panorama leads to the need to seek arguments on how technological and organizational innovation are inside the core of more popular and strategic discourses on sustainability.

About these assumptions, Bessant and Tidd (2009) highlight that the more conventional approach for innovation and sustainability is how to influence the innovation development and the application through regulation and control. Hence, the use of formal politics in order to direct the innovation by regulation systems, goals and stimulus also provide punishment for non-conformity.

Based on argument presented about sustainability and innovation, it is possible allege that the second play a central role to help the creation a sustainable future by conventional means, such as new processes, products and services, but also through providing changes in organizations, businesses and in behaviors (SCHUMPETER, 1982).

This work has as aim to analyze the international panorama of publications involving the theme sustainability and innovation in the administration area. Thereunto, the emergency and importance to study this theme orients a bibliometric study on publications in the period from 2002 to 2012.

Therefore, besides the number of publications, it is searched discuss some aspects such: a) authors with high number of publications, b) publication sources (journals), c) number of publications per year, d) institutions, e) countries and f) languages. Beyond these aspects, we search analyze factors like those related to *citation report*, and observe the impact factor (*index h-b e m*) by publications about the theme searched.

The article presents in its structure, beyond this introduction, five else sections: bibliographic review, methods, analysis of results, final considerations and references.

2 SUSTAINABILITY

In the last decades, a new consciousness on the matters about the environment has arising. It is due to the population growth, linked to the disorderly consumption of natural richness without their appropriate reposition. Hart and Milstein (2003, p. 66) highlight the context when they define sustainability as “capacity to satisfy the needs nowadays without commit the capacity for future generations satisfy their own needs”.

Jacobi and Besen (2011) deepen this discussion when they underline that one of the higher challenges that modern society faces is the equation of excessive generation and the final disposition environmentally safe for solid waste. Capra (2005) shares this vision and detaches as one of the main obstacles to the sustainability, the continuous increase of material consumption by the modern society, linked to the world population growth in the last decades.

Dyllick and Hockerts (2002), who contrast the matter of economic growth and the social equality that have been discussed along the years, corroborate this vision. For these

authors, when add concern with global capacity for sustainable development of natural systems, it is obtained a configuration of main challenges faced by humanity nowadays.

Still about this discussion, Hart and Milstein (2003) highlight that sustainability is not conflicting with economic growth. On the contrary, it may be an important competitive advantage and generate value for shareholders and the community in general. On this argument, Sachs (2001) detaches the economic growth. Whether planned in an appropriate way, in order to minimize environmental negative impacts and available for services with socially intended results, it passes to be a necessary condition for development.

Jabbour and Santos (2011) take the sustainability debate to the organization scope and understand that environmental consciousness by companies translate its maturity to treat ecological issues. While Barbieri (2004) underlines that the solution for environmental issues, or their minimization, requires a new attitude by businesspeople and administrators, who pass to consider the environment in their decisions and adopt administrative and technological concepts. This stance could lead them to emphasize sustainability in their decisions adopting strategies in order to assuage or solve socio-environmental matters.

Sharing the same precepts, Hart and Milstein (2003) highlight that, in order to be considered sustainable, a company should be able to generate in simultaneous way benefits related to three pillars of sustainability: economic, social and environmental. An important aspect for organization is related with how they can adequate their profiles to the new ecological demands, using strategies to protect natural resources, which are the base for maintenance of life in the Earth. About this debate, Aligreri, Aligreri and Krugliankas (2009, p. 9) detach that:

The concern with politically correct, environmentally sustainable and viable economically stances will stay increasingly present among management themes. In this sense, the socio-environmental responsibility may be noticed as one of the more debated themes, becoming an important variable in the competitive strategy for companies.

This fact is also discussed by Tachizawa (2006), when consider that one way to ensure the success in socio-environmental management is directly related with awareness of all, in other words, heads of government, environmental agencies, industries, entities and society.

3 INNOVATION

From the 90s, in more representative way, innovation started to be a determinant success factor, for companies, for countries and for the society in general (VASCONCELLOS, 2003). Based in this same understanding, Schumpeter (1982, 1942) starts to distinguish inventions (new ideas and concepts) from innovation (a new combination of productive resources).

According to Engel, Blackwell and Miniard (2000), the innovation consists in any idea or product noticed by the potential consumer as something new. Damanpour (1991), who shares this vision, also complements it when highlights that innovation can be a product or service, a new technology of the production process, a new administrative system, a new organizational structure or a new plan or program. Under these precepts, it is possible comprehend the innovative activity as a process that aims to transform opportunities in new ideas and practice them. In other words, as the result of innovative act or effect to become something new, renew, or insert a novelty (TIDD; BESSANT; PAVITT, 2005).

To deepen the study on organizational scope, Chandler (1997) and Damanpour (1991) have investigated new ways of organization and the relationship between organizational attributes to occur innovation. On the other hand, Hamel (2007) alleges that innovation in management is related with novelties in management principles, politics, practices, processes, knowledge, methods and techniques. Tigre (2006) shares this understanding and complements highlighting that innovative practices allow the organization enjoy technological innovations, adjusting itself to the context.

For Schumpeter (1982), there are five different kinds of innovation: i) introduction of new products in the market or of improved products that exist before; ii) new production methods; iii) opening up new markets; iv) use of new sources of raw material; and v) emergence of new ways to organize an industry.

Besides these differentiations, Schumpeter (1954) relates innovation with development, especially when asserts:

[...] what we, in a non-scientific way, use to call economic progress, means essentially place productive resources in use that has not been tried before in practice, and take them from the use that they had until the moment. That is we have called innovation. (SCHUMPETER, 1954, p.31).

In Schumpeter thoughts (1982), both the existence and permanence of companies in the market are possible from the moment in which they start to innovate, creating and recreating their structures in order to seek new solutions for emergent markets. In this way, innovation becomes a continuous process in a movement of destruction creator in which the company assimilates knowledge and generates new ideas, producing new combinations that revolutionize the economic structure, destructing the old one and providing economic development (SCHUMPETER, 1942).

About these assumptions, it is important detach that innovation has a lifetime and, after this time, the company that had a competitive advantage through an innovative action is subjected to be outdated by aggressive competitors (PORTER, 1998).

4 SUSTAINABILITY AND INNOVATION

The environmental dimension is configured increasingly as a matter that involves a set of actors from the education universe, which potentiate the adherence of several knowledge systems, professional training and the society as a whole (JACOBI, 2003). Nowadays, a society's awareness has increased before socio-environmental matter. In the core of cultural transformation that have happened from 60's and 70's decades, have achieved some dimension and placed the environment as one of the fundamental principles of the modern man (SOUZA, 2000).

Before this reality, it is necessary think about a new developmental with emphasis on socio-environmental sustainability. Otherwise, it is possible generate an impossibility to solve growth and complex environmental issues and revert their causes with no extreme change in the knowledge, values and behavior systems (LEFF, 2001).

From the presented arguments, it is possible consider that a sustainable and innovative organization is not that which introduces innovations of any kind, but innovation that attend to the dimensions of sustainability in systematic bases and take positive results to the company, the society and the environment (BARBIERI, 2007).

This new developmental profile, known in the contemporary society as sustainable development acquires several definitions that seek integrating the three dimension of sustainability, in other words, economic viability with ecological prudence and

social justice (ALMEIDA, 2002). For Barbieri (2007), attending these dimensions become the innovation process more sophisticated and demanding, what require higher efforts from the organization to attend technically the new requirements.

Based on these assumptions, Schot and Geels (2008) highlight that, according with the concepts of sustainability and sustainable development, innovations should generate economic, social and environmental positive results simultaneously, what is not easily feasible given the uncertainties that innovations provide.

For Schot and Geels (2008), it is relatively easy to prewise the economic effects, because there is a great quantity of instrument developed to perform it. On the other hand, it is difficult to evaluate previously social and environmental effects, once they involve a lot more variables, uncertainties and interactions. Before this panorama, the same authors detach that sustainable development requires a combination of technical and social changes, because these transformation are deeply related between them.

In this perspective, innovation is linked to the obtaining sustainable advantages, to the competitive positioning and to the organizations learning. It is possible assert that innovation arises as a fundamental element of action and differentiation of companies (PORTER, 1998; HAMEL, 2007). About this argument, Davila, Epstein and Shelton (2007, p. 31) defend that innovation needs to be aligned with company's strategy, because should "determine kinds and quantities necessary to support the business strategy".

Finally, Daroit and Nascimento (2000) highlight that innovation, associated with environmental matter, can provide the arising of important technological innovations, which can configure small improvement in the routine activities and even great changes of products and processes that aims to achieve organizational goals.

For the authors previously cited, an organization with knowledge about market and focus in research and development, in order to innovate, increase its chances to develop new solutions that can enlarge its competitive advantage and generate opportunities for business. Daroit and Nascimento (2000) believe that sustainable innovation should not focus only on the market demands, but also considering the needs from the society aiming the company's financial well fare and the quality of life.

5 METHODS

To achieve the aims proposed, we have performed a bibliometric research, which constitutes a new measurement technique of production indexes and dissemination of scientific knowledge from the application of statistical and mathematics techniques. Bibliometry, since from its origin, was marked by a double concern: the analysis of scientific production and the search by immediate practical benefits in library for better efficiency in the library management services (FONSECA, 1986).

To enlarge the comprehension about this kind of studies, Araújo (2006) detaches that the more important area from bibliometry is the analysis of quotes, which contributes to the science development. According to this author, bibliometric studies provide the possibility to recognize a scientist by other researchers to establish property rights and priority of scientific contribution, what constitute important information source, beyond help to judge habits of information use.

The analyses performed were sustained by qualitative and quantitative approaches. In the quantitative approach the total number of publications was characterized, beyond following variables: a) authors with higher number of publications, b) journals (publications sources), c) number of publications per year, d) institutions, e) countries and f) languages. Posteriorly, in order to contemplate the aim previously proposed, the number of times that each publication was quoted through the *index h-b* and *index m* was performed.

The *h-b index* is presented by Banks (2006) as an extension of the *h-index*, presented by Hirsch (2005), which has as function quantify the impact and the relevance of individual scientific production. These contributions allowed achieving the *h-b index* obtained by the number of quotes about a topic or combination in an established period, listed in descending order of quotes.

Studies by Banks (2006) also present and explain the *m-index*, obtained through division of the *h-b index* by the period of years in which the information is demanded (*n*); in this work is 10 years. To analyze the *m-index*, it should be take into account the following considerations:

- $0 < m \leq 0.5$: topic/combination can be of the interest for researchers in an specific research field, where the field encompass a small community;

- $0.5 < m \leq 2$: topic/combination probably could be a “hot-topic” as research area, where the community is greater or the topic/combination present very interesting characteristics;
- $m \geq 2$: it is an exclusive topic/combination, where the consequences has an achieve not only in its research area. It is probably a topic/combination with unique application effects or characteristics.

Madruaga and Silva (2008) previously used the “hot-topics”, according with detached above, in order to analyze publications about the sustainability in *ISI Web of Science* databank. Velter et al. (2010) and Xavier et al. (2012) performed other studies that provide inputs through which the present work can be carried out. These authors have sought deepen the knowledge about publications in sustainable area and identify what kind of administration related to this theme are considered “hot-topics”.

a. Stages and data collection

For data collection about publications in this bibliometric study, the *ISI Web of Science* database of quotes index by *ISI Citation Indexes* was used, published by the first time in 1963, with data about quotes from 1961 (GARFIELD, 1963). This database offers direct access to the multidisciplinary flow of information on approximately nine thousand international journals of high factor of impact for the scientific research (THOMSON SCIENTIFIC, 2011).

Through an adaptation of the method previously used by Velter et al. (2010) and Xavier et al. (2012), the research was divided into 4 stages (described by Frame 2). On the first stage, the terms for survey were defined: “sustainability” and “innovation”. They were searched jointly, in a search by publications that contained both terms as keywords in the “abstract”.

The delimitation of the period of publications were determined from 2002 to 2012, resulting in 1,365 publications. However, we highlight that the survey about 2012 occurred at the end of June, and it makes impossible consider this year in its totality. In this way, to mediate this issue, to calculate the *h-b* and *m indexes*, the period used was 10.5 years.

Posteriorly, among several kinds of publication obtained, only scientific articles were considered, reducing the total number of publication in analysis into 900. Next, a filtering

by thematic area was carried out, restricting to those in which is supposed that are related to the administration field. After these steps, the following 15 thematic areas were selected, according to the categories presented by *Web of Science* database (Frame 1):

Frame 1 – *Web of Science* Categories

Web of Sciences Categories		
<i>Management (151)</i>	<i>Geography (36)</i>	<i>Social Sciences Interdisciplinary (13)</i>
<i>Environmental Studies (139)</i>	<i>Operations Research Management Science (30)</i>	<i>Hospitality Leisure Sport Tourism (7)</i>
<i>Business (115)</i>	<i>Urban Studies (29)</i>	<i>International Relations (6)</i>
<i>Planning Development (81)</i>	<i>Multidisciplinary Sciences (23)</i>	<i>Business Finance (5)</i>
<i>Economics (69)</i>	<i>Public Administration (16)</i>	<i>Humanities Multidisciplinary (5)</i>

Source: authors from *ISI Web of Science* database (2012)

The first step in the research allowed a survey of the following information about the publications selected: a) authors with higher number of publications, b) journals (publication sources), c) number of publications per year, d) institutions, e) countries, and f) languages.

Frame 2 – Stages of research

<p>1st Stage</p> <ul style="list-style-type: none"> • Surveying the terms “<i>sustainability</i>” and “<i>innovation</i>” (2002 - 2012) in keywords • Refining the survey selecting the articles as the kind of document • Filtering the areas related to the administration • Research: total number of publications, authors with higher number of publications, journals (publication sources), number of quotes per year, institutions, countries and languages
<p>2nd Stage</p> <ul style="list-style-type: none"> • Survey in <i>Citation Report</i> • Analysis of factor of impact of the theme (<i>h-b</i> and <i>m indexes</i>)
<p>3rd Stage</p> <ul style="list-style-type: none"> • Analysis of 10 more quoted publications • Authors, journals, total of quotes, number of quotes per year
<p>4th Stage</p> <ul style="list-style-type: none"> • Listing the number of publications by author and the publications more quoted

Source: authors from *ISI Web of Science* database (2012)

In the second stage, a search was performed in the system by analysis of *citation report*. It was searched observe the impact factor (*h-b* and *m indexes*) of publications which involve the themes searched. Next (3rd stage), the 10 publications detached by the database that received more quotes in the period surveyed were analyzed, observing aspects such as: a) authors, b) journal, c) total quotes, and d) number of quotes per year.

Finally, the authors that have more publications about the themes were searched, covered to the results of publications with higher number of quotes, in order to observe consonances/dissonances. This concern is due to the fact that the total number of articles published, even measure the author's productivity, it does not measure the importance and/or impact by his/her publications, what can be measured by the number of quotes that each one receive, measured by *h-index* (HIRSCH, 2005).

6 PRESENTATION AND DATA ANALYSIS

This section has as aim presenting a panorama about international scientific production involving the theme sustainability and innovation in areas related with administration in the period from 2002 to 2012. Thereunto, the aspects initially detached are: a) authors with higher number of publications, b) journals (sources of publications), c) number of publications per year, d) institutions, e) countries, and f) languages.

Next, an analysis about the impact of publications selected is performed, highlighting the aspects referent to *citation report* and the 10 publications found that received higher number of quotes.

a. Studies about sustainability and innovation

Firstly, about the authors who have published on the theme sustainability and innovation, considering the selected areas related with administration (Frame 3), those who presented three or more publications were detached, presenting 13 names.

It is important highlight that, even the intention was listed the first twenty, only thirteen were detached, because the higher number of authors have presented two or less publications per year.

Frame 3 – Authors with higher number of publication about sustainability and innovation

Authors (countries)	Number of articles by author
Wagner M. (Germany)	8
Geels F.W. (England)	7
Hall J. (Canada)	5
Raven R. P. J. M. (Netherlands)	4
Smith A. (England)	4
Truffer B. (Switzerland)	4
Kern F. (England)	3
Matos S. (Portugal)	3
McDowall W. (England)	3
Pinkse J. (Netherlands)	3
Sarkis J. (USA)	3
Vergragt P. J. (USA)	3
Weczorek A. J. (Netherlands)	3

Source: authors from *ISI Web of Science* databank (2012).

Related with the Frame 3, it is possible observe that the author with the higher number of publication is from Germany (8 publications), four English authors are detached among the thirteen firsts (17 publication in total), two Dutch (7 publications in total) and two Americans (6 publications in total). Related with Brazilians, eight names were found (Barbieri, J. C., Pedrozo, E. A., Morel, C. M., Jabbour, C. J. C., Borger, F. G. F., Garcez, M. P., de Hoyos, A., and Goldman, F. L). However, they are not presented in the group because present a single publication each one.

After presentation of authors who have higher number of publications about the theme, the journals (sources of publication) that highlight the higher number of articles about sustainability and innovation were observed (Frame 4).

Frame 4 – Journals (sources) with higher number of publications about sustainability and innovation

Journal	Number of publications
<i>Technological Forecasting and Social Change</i>	22
<i>Ecological Economics</i>	21
<i>Energy Policy</i>	19
<i>Research Policy</i>	16
<i>Technology Analysis Strategic Management</i>	14

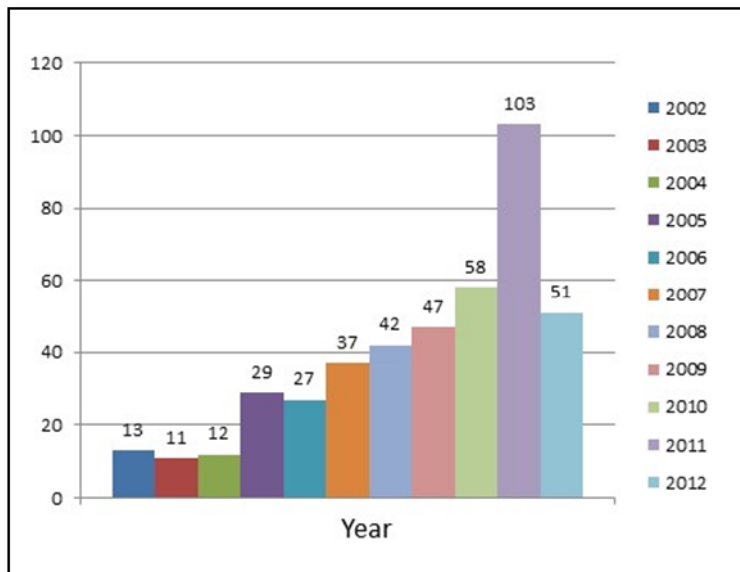
<i>Business Strategy and the Environment</i>	13
<i>Journal of Business Ethics</i>	12
<i>Futures</i>	11
<i>International Journal of Technology Management</i>	8
<i>Proceedings of the National Academy of Sciences of the United States of America</i>	8
<i>Technovation</i>	8
<i>European Planning Studies</i>	6
<i>Global Environmental Change Human and Policy Dimensions</i>	6
<i>International Journal of Production Research</i>	5
<i>Journal of Business Venturing</i>	5
<i>Journal of Environmental Management</i>	5
<i>Society Natural Resources</i>	5
<i>Sustainable Development</i>	5
<i>African Journal of Business Management</i>	4
<i>Ecology and Society</i>	4

Source: authors from *ISI Web of Science* database (2012)

About the frame 4, among the 20 journals (sources) that presented more publications about the theme, the *Technological Forecasting and Social Change* is in the first position with 22 publications. *Ecological Economics* (21), *Energy Policy* (19), *Research Policy* (16), *Technology Analysis Strategic Management* (14), *Business Strategy and the Environment* (13), *Journal of Business Ethics* (12) and *Futures* (11) present a number higher than 10 articles published. Moreover, none among the twenty journals is Brazilian, detaching a discrepancy in the national studies about the theme when compared with the international frame.

Next, after highlight the sources with more publications about the theme, the evolution of number of publications per year was observed in the period from 2002 and 2012, according to the Graph 1.

Graph 1 – Number of publications about sustainability and innovation per year, in the period 2002-2012



Source: authors from ISI Web of Science databank (2012).

The time-history of publications in the Graph 1 notices a gradual increase in the period detached, intensified mainly in 2011. Furthermore, in 2012, even presenting 51 publications, the results show tendencies to provide similar results to the previous year, because only the first semester was considered due to the period of perform this research.

Next, the firsts twenty institutions (and their countries were identified) which have published articles about sustainability and innovation, considering the administration field in the period detached (Frame 5).

Frame 5 – Institutions with higher number of publications about sustainability and innovation

Institutions (countries)	Number of publications
Eindhoven University of Technology (Netherlands)	13
University of Sussex (England)	13
Clark University (USA)	8
University Michigan (USA)	8
Cardiff University (Wales)	7
Delft University Technology (Netherlands)	7
Vrije University Amsterdam (Netherlands)	6
Simon Fraser University (Canada)	5
University Amsterdam (Netherlands)	5
University of California (USA)	5
University Utrecht (Netherlands)	5
Wageningen University and Research Centre (Netherlands)	5

Arizona State University (USA)	4
Erasmus University (Netherlands)	4
Griffith University (Australia)	4
Harvard University (USA)	4
Massachusetts Institute of Technology (USA)	4
National University of Singapore (Singapore)	4
Open University (Netherlands)	4
University College London (England)	4

Source: authors from *ISI Web of Science* databank (2012)

The data presented in the Frame 5 demonstrate that the institutions detached were *Eindhoven University of Technology* (Netherlands) and *University of Sussex* (England) with 13 publications each one, followed by *Clark University* (USA) and *University Michigan* (USA), both with 8 publications. Moreover, among the institutions that published more articles about the theme are most Dutch and Americans, which present 49 and 33 publications, respectively.

About the institutions that have published more articles on sustainability and innovation, any Brazilian institution was mentioned in the Frame 5 because the only University that obtained publications related with these themes was the University of São Paulo – USP, which presented two publications in the database.

Posteriorly, the number of publications by country inside the period determined was identified, according to the Frame 6.

Frame 6 – Publications by country

Country	Number of publications
United States of America	117
England	58
Netherlands	54
Germany	35
Spain	31
Australia	29
Canada	27
France	18
Italy	18
Sweden	18
Switzerland	13
Austria	11
Norway	9

China	9
Wales	8
Denmark	7
Japan	7
Portugal	6
Scotland	5
Singapore	5

Source: authors from *ISI Web of Science* databank (2012)

Through the Frame 6 is possible observe that the United States of America lead the *ranking* of those which have more publications with 117 studies, followed by England (58), Netherlands (54), Germany (35), Spain (31), Australia (29), Canada (27), France (18), Italy (18) and Sweden (18). Brazil even does not appear in the list of the first twenty, stays in the 23rd position with 4 publications.

Finally, linked to the countries that most originated publications about the theme, the languages in which the publications were written are described according to the Frame 7.

Frame 7 – Languages of publications

Language	Number of articles
English	435
Spanish	8
German	4
Polish	1
Portuguese	1
Slovak	1

Source: authors from *ISI Web of Science* database (2012).

The Frame 7 shows that the English language is prevalent in the publications involving sustainability and innovation as theme in the administration area, with 435 articles (96.66%). Next, Spanish appears (8 publications), followed by German (4 publications), Polish, Portuguese and Slovak (1 publication each one).

b. Analysis of the impact of publications about sustainability and innovation

In order to verify the relevance of studies involving the combination of sustainability and innovation as theme, an analysis of “*citation report*”, according with exposed by *Web of Science* was performed aiming to present the *h-b* and *m indexes*. About

the 450 articles selected by this base, the following data were obtained, according with the Frame 8:

Frame 8 – *Citation Report* of *Web of Science* database about Sustainability and innovation as theme

Citation Report	Results
Results found	450
Quote medium by item	7.18
<i>h-b</i> index	30
<i>m</i> index	2.85

Source: authors from *ISI Web of Science* databank (2012).

From data presented by the Frame 8, the ***h-b index*** of publications involving sustainability and innovation as theme is equal **30**, and consequently the ***m index*** is equal **2.85**. It shows that the results of the themes studied can be considered “*hot-topic*”, in other words, they have relevant representativeness in the international scenery in the period 2002 – 2012.

After detach the relevance about sustainability and innovation as theme by *h-b* and *m indexes*, *Web of Science* detached 10 publications as the more cited in the period detached, according to with Frame 9.

Frame 9 – Publications more cited in the period 2002-2012

References	Number of citations	Citations per year
1) Vohora, A.; Wright, M.; Lockett, A. Critical junctures in development of university high-tech spinout companies. <i>Research Policy</i> , v.33, n.1, p.147-175, Jan./2004.	112	12.44
2) Bettencourt, L. M. A.; Lobo, J.; Helbing, D. Growth, innovation, scaling, and the pace of life in cities. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , v.104, n.17, p.7301-7306, Apr./2007.	112	18.67
3) Label, L.; Anderies, J. M.; Campbell, B. Governance and the capacity to manage resilience in regional social-ecological systems. <i>Ecology and Society</i> , v.11, n.1, Jun./2006.	104	14.86
4) Johnson, K.; Hays, C.; Center, H. Building capacity and sustainable prevention innovations: a sustainability planning model. <i>Evaluation and Program Planning</i> , v.27, n.2, p.135-149, May./2004.	69	7.67
5) Brown, K.	60	5.45

Innovations for conservation and development. <i>Geographical Journal</i> , v.168, p.6-17, Mar./2002.		
6) Waggoner, P. E.; Ausubel, J. H. A framework for sustainability science: a renovated IPAT identity. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , v.99, n.12, p.7860-7865, Jun./2002.	59	5.36
7) Sanden, B. A.; Azar, C. Near-term technology policies for long-term climate targets economy wide versus technology specific approaches. <i>Energy Policy</i> , v.33, n.12, p.1557-1576, Aug./2005.	55	6.88
8) Verbong, G.; Geels, F. W.* The ongoing energy transition: lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960-2004). <i>Energy Policy</i> , v.35, n.2, p.1025-1037, Feb./2007.	55	9.17
9) Capaldo, A. Network structure and innovation. The leveraging of a dual network as a distinctive relational capability. <i>Strategic Management Journal</i> , v.28, n.6, p.585-608, Jun./2007.	55	9.17
10) Chesbrough, H. W.; Appleyard, M. M. Open innovation and strategy. <i>California Management Review</i> , v.50, n.1, 2007.	51	8.50

Source: authors from *ISI Web of Science* databank (2012)

About 10 publications with have received more citations, the journal *Energy Policy* appears as the higher, because it is related with 3 publications and sums 214 citations. It is followed by *Proceedings of the National Academy of Sciences of the United States of America*, source of two publications that sum 171 citations. Other journals present one publication among the 10 more cited, and the *Research Policy* is detached with 112 citations.

Furthermore, the article "*Growth, innovation, scaling, and the pace of life in cities*", written by Bettencourt, L. M. A.; Lobo, J. and Helbing, D., presents the higher number of citations per year (18.67). It is followed by "*Governance and the capacity to manage resilience in regional social-ecological systems*" (14.86), written by Label, L.; Anderies, J. M. and Campbell, B. Next there is "*Critical junctures in development of university high-tech spinout companies*" (12.44), written by Vohora, A.; Wright, M. and Lockett, A. These articles are the only one that showed a number of annual citations higher than 10 and, consequently, causes higher impact.

Finally, another relevant aspect referent to the more cited articles is because one of the authors listed among those who have more publications about the theme sustainability and innovation (Geels, F. W. – 2nd author with higher number of publications) appears in 10 *Revista Eletrônica de Estratégia & Negócios*, Florianópolis, v.6, n.3, set./dez.2013.

more cited articles. “*The ongoing energy transition: lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960-2004)*”, the 8th article with higher number of citations in 55 (9.17 per year) by this author.

7 DISCUSSION ABOUT RESULTS AND FINAL CONSIDERATIONS

From the results obtained by this study, a progressive annual growth is noticed in the total number of publications. The “*boom*” is in 2011, when the increase was approximately 77% related with the previous year, and this index should be the same or increase in 2012, given the data referent to 2012 were related only about the first semester. These information highlights the topicality, and that this theme is achieving relevance and higher discussion in the international scope in several areas, especially in those related with management, environmental studies and business, which present a number of publications over 100 (Frame 1). Moreover, the multidisciplinary character of the theme points to a diversity of approaches, comprehensions and applications.

Among the authors with higher number of publications, Wagner M. presents 8 publications and is detached related to the others (Frame 3). However, this number is not expressive before the total of publications (900 articles). It can point to a possible difficulty to indicate a researcher or a group as “obligatory reference” in discussions about the theme. Furthermore, even this fragility could be noticed, the authors pointed may be seen as some of those who we should start the elaboration of theoretical frameworks about the theme.

Another relevant point may be observed in relation to the information about the 25 institutions with higher number of publications about the theme (Frame 5), because they can help research groups to find other international groups who works with the theme to establish partnerships and interchange among researchers. In a complementary way, the information about the language shows that English is the prevalent language with almost 97% of publications analyzed.

Related with countries with higher quantity of publications (Frame 6), the United States is the first in the list (with more than twice publications when compared with the second); England and Netherlands are expressively in front of the others in the *ranking* publications. On the other hand, Brazil presents a small detach, although does not appear in the international frame of publications, in the 23rd position with 4 publications. It shows that Revista Eletrônica de Estratégia & Negócios, Florianópolis, v.6, n.3, set./dez.2013.

the national field of studies is underexplored and evidences the necessity to perform a higher number of studies to discuss this theme within the Brazilian reality.

It is important highlight that the authors with higher number of publications are not necessarily higher relevant to the academic knowledge when observed the number of times that other works were cited. We have inferred it because only one author appear in both lists (Geels, F. W.) as the 2nd with higher number of publications, but 8th more cited (55 citations).

Likewise, Wagner M. is the leader in the *ranking* authors with higher number of publications, but there is no publication by him among the 10 more cited. The information shows that the author who present the higher number of publication is not necessarily more relevant (impactful) for academic knowledge because the number of citations with his/her contributions reproduced in other works.

From these analyses, we can infer that *h-b* and *m indexes*, of publications involving the themes sustainability and innovation is equal 30 and 2.85, respectively. These data show that studies about these theme can be considered "*hot-topic*", in other words, they are relevant for the international scenery and deserve attention by researchers from all over the world and all the areas.

Finally, we can assert that the results obtained by this bibliometric research are relevant in the construction of scientific knowledge on the theme sustainability and innovation. However, the study was performed only in the international *ISI Web of Science* database, what can be considered a limitation. For this reason, we suggest future studies with higher amplitude (both national and international) in order to contemplate, compare and corroborate the results from this research. Another suggestion is related to the period investigated, which can include other years, maybe higher than delimited in this study.

As another propose, we suggest a deepening related to the authors and articles which presented higher number of citations in order to analyze the main approaches of their researches. This measure may evidence (for example, through keywords) some topics of higher relevance related to the theme proposed in this study.

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